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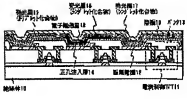
(54) LIGHT EMITTING DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a light emitting device with which color display of good color balance is made possible.
SOLUTION: A triplet compound is used as light emitting layers 15 of EL elements which emit red light of the light emitting device for making color display and a singlet compound is used as the light emitting layers 16 of the EL elements which emit the green light and the light emitting layers 17 of the EL elements which emit the blue light. As a result, the operating voltage of the EL elements which emit the red light may be unified to that of the EL elements which emit the green light and the EL elements which emit the blue light, by which the color display of the good color balance is made possible.



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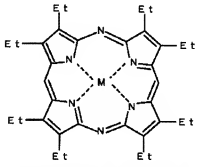
CLAIMS

[Claim(s)]
[Claim 1] In the luminescence equipment containing the EL element electrically connected to the picture element part at Switching TFT, the current control TFT, and this current control TFT Said switching TFT is the n channel mold TFT, and said current control TFT is the p channel mold TFT. To said picture element part The pixel containing the pixel containing the EL element which emits light in red, the pixel containing the EL element which emits light green, and the EL element that emits light blue is prepared. Luminescence equipment characterized by using a triplet compound for the EL element which emits light in said red, and using a singlet compound for the EL element which emits light in the EL element which emits light in said green, or said blue.
[Claim 2] In the luminescence equipment containing the EL element electrically connected to the picture element part at Switching TFT, the current control TFT, and this current control TFT Said switching TFT is the p channel mold TFT, and said current control TFT is the n channel mold TFT. To said picture element part The pixel containing the pixel containing the EL element which emits light in red, the pixel containing the EL element which emits light green, and the EL element that emits light blue is prepared. Luminescence equipment characterized by using a triplet compound for the EL element which emits light in said red, and using a singlet compound for the EL element which emits light in the EL element which emits light in said green, or said blue.
[Claim 3] In the luminescence equipment containing the EL element electrically connected to the picture element part at Switching TFT, the current control TFT, and this current control TFT Said switching TFT is the n channel mold TFT, and said current control TFT is the n channel mold TFT. To said picture element part The pixel containing the pixel containing the EL element which emits light in red, the pixel containing the EL element which emits light green, and the EL element that emits light blue is prepared. Luminescence equipment characterized by using a triplet compound for the EL element which emits light in said red, and using a singlet compound for the EL element which emits light in the EL element which emits light in said green, or said blue.
[Claim 4] In the luminescence equipment containing the EL element electrically connected to the picture element part at Switching TFT, the current control TFT, and this current control TFT Said switching TFT is the p channel mold TFT, and said current control TFT is the p channel mold TFT. To said picture element part The pixel containing the pixel containing the EL element which emits light in red, the pixel containing the EL element which emits light green, and the EL element that emits light blue is prepared. Luminescence equipment characterized by using a triplet compound for the EL element which emits light in said red, and using a singlet compound for the EL element which emits light in the EL element which emits light in said green, or said blue.
[Claim 5] Setting to any 1 of claim 1 thru/or claims 4, said triplet compound is a formula [a formula 1].



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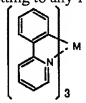
Luminescence equipment which comes out and is characterized by being the organic compound shown.
[Claim 6] Setting to any 1 of claim 1 thru/or claims 4, said triplet compound is a formula [a formula 2].



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Luminescence equipment which comes out and is characterized by being the organic compound shown.
[Claim 7] The element which belongs to eight to 10 group of said periodic table in claim 5 or claim 6 is luminescence equipment characterized by being platinum, iridium, nickel, cobalt, or palladium.
[Claim 8] It is luminescence equipment characterized by said switching TFT and said current control TFT being the bottom gate molds TFT in any 1 of claim 1 thru/or claims 7.
[Claim 9] It is luminescence equipment characterized by said switching TFT and said current control TFT being the reverse stagger molds TFT in any 1 of claim 1 thru/or claims 7.
[Claim 10] The module characterized by including luminescence equipment according to claim 1 to 9.
[Claim 11] The electric appliance characterized by using luminescence equipment according to claim 1 to 9.
[Claim 12] The cellular phone characterized by using luminescence equipment according to claim 1 to 9.
[Claim 13] The digital camera characterized by using luminescence equipment according to claim 1 to 9.
[Claim 14] The audio equipment characterized by using luminescence equipment according to claim 1 to 9.
[Claim 15] The approach of the luminescence equipment characterized by operating an EL element according to claim 1 to 9 on the electrical potential difference not more than 10V of operation.

[Translation done.]

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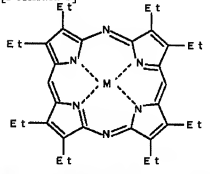
DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the equipment (henceforth luminescence equipment) which has the component (henceforth a light emitting device) which inserted the luminescent ingredient into inter-electrode. It is related with the luminescence equipment which has a light emitting device (henceforth an EL element) using the organic compound with which EL (Electro Luminescence) is obtained especially as a luminescent ingredient. In addition, an organic electroluminescence display and organic light emitting diode (OLED:Organic Light Emitting Diode) are contained in the luminescence equipment of this invention.
[0002] Moreover, the luminescent ingredient which can be used for this invention contains all the luminescent ingredients that emit light via singlet excitation, triplet excitation, or both excitation (phosphorescence and/or fluorescence).
[0003]
[Description of the Prior Art] In recent years, development of the EL element using the organic electroluminescence film as a luminous layer progresses, and the EL element using various organic electroluminescence film is proposed. And the attempt which realizes a flat-panel display using luminescence equipment using such an EL element as a light emitting device is made.
[0004] The passive matrix mold and the active-matrix mold are known by the luminescence equipment using an EL element. A passive matrix mold is luminescence equipment using the EL element which consists of structure which prepared stripe-like an anode plate and cathode so that it might intersect perpendicularly mutually, and sandwiched EL film between them. Moreover, a active-matrix mold is a method which controls the current which flows to an EL element by TFT which prepared the thin film transistor (hereafter referred to as TFT) for every pixel, and was connected to one of the two of the anode plate of an EL element, or cathode.
[0005] Moreover, although various approaches as a method to which color display of the luminescence equipment using an EL element is carried out are proposed, the method which performs color display is learned by carrying out color mixture of the luminescence for three pixels, the pixel which emits light in red, the pixel which emits light green, and the pixel which emits light blue, as one unit.
[0006] Although this method attracts attention from it being easy to obtain bright color display, in order that the EL element which emits light in each color may use respectively different organic electroluminescence film as a luminous layer, the brightness properties (relation of the brightness to operating voltage) of a luminous layer differ. Consequently, operating voltage required to obtain desired brightness will differ for every EL element, and the dependability (life) of a luminous layer will differ for every EL element further.
[0007] We were anxious about the problem of the class of the thing [above] of power source required for luminescence equipment not only increasing, but causing possibility of producing a gap of the color balance by the difference in the life (rate of degradation) of an EL element.
[0008]
[Problem(s) to be Solved by the Invention] In carrying out color display of the luminescence equipment, this invention makes it a technical problem to offer the technique for arranging the operating voltage of the EL element of red luminescence, the EL element of green luminescence, and the EL element of blue luminescence. And let it be a

technical problem to offer the luminescence equipment which makes good color display of color balance possible.
[0009] Furthermore, let it be a technical problem to offer an electric appliance with the good display of image quality by using for a display the luminescence equipment which makes good color display of color balance possible.
[0010]
[Means for Solving the Problem] In this invention, the description is that it uses together the organic compound (it is hereafter called a triplet compound) which emits light by the organic compound (it is hereafter called the singlet compound) and triplet exciton (triplet) which emit light by the singlet exciton (singlet) as a luminous layer. In addition, a singlet compound points out the compound which emits light only via singlet excitation into this specification, and a triplet compound points out the compound which emits light via triplet excitation.
[0011] If it considers as a triplet compound, the organic compound of a publication is mentioned to the following papers as a typical ingredient.
(1) T.Tsutsui and C.Adachi, S. Saito and Photochemical Processes in Organized Molecular Systems, ed.KHonda (Elsevier Sci.Pub., Tokyo, 1991), and p.437.(2) M.A.Baldo, D.F.O'Brien, and Y.You, A. -- Shoustikov, S.Sibley, M.E.Thompson, S.R.Forrest, and Nature 395 (1998) p.151. -- the organic compound shown in this paper by the following formula is indicated.
(3) M.A.Baldo and S.Lamansky, P. E.Burrrows and M.E.Thompson, S. R.Forrest, Appl.Phys.Lett., and 75 (1999) p.4.
(4) T.Tsutsui, M.-J.Yang, M.Yahiro, KNakamura, and T.Watanabe, T. (1999) tsuji, Y.Fukuda, T.Wakimoto, S.Mayaguchi, Jpn.Appl.Phys., 38 (12B) L1502. [0012] Moreover, this invention person thinks it possible to use the luminescent ingredient (specifically a metal complex or an organic compound) expressed not only with the luminescent ingredient indicated by the above-mentioned paper but with the following molecular formula.
[0013]
[Formula 1]



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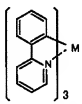
[0014]
[Formula 2]



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[0015] In the above-mentioned molecular formula, M is an element belonging to eight to 10 group of a periodic table. Platinum and iridium are used in the above-mentioned paper. Moreover, this invention person thinks that nickel, cobalt, or palladium is desirable when reducing the manufacturing cost of luminescence equipment, since it is cheap compared with platinum or iridium. The productivity of especially nickel is also highly desirable in order to tend to form a complex.

[0016] The above-mentioned triplet compound has luminous efficiency higher than a singlet compound, and can make low operating voltage (electrical potential difference made to require for an EL element to emit light) also obtaining the same luminescence brightness. This description is used in this invention.
[0017] The cross-section structure of the picture element part in the luminescence equipment of this invention is shown in drawing 1 . As for the luminous layer to which an insulator layer (henceforth a bank) with [12 / the current control TFT and / top / pixel electrode / the pixel electrode (anode plate) / 10 / 11 / an insulator and] opening in 13 and 14 emit light to a hole injection layer, and 15 emits light in red, the luminous layer to which 16 emits light green, the luminous layer to which 17 emits light blue, and 18, in drawing 1 , an electronic transportation layer and 19 are cathode.
[0018] In addition, although drawing 1 shows the example which uses the bottom gate mold TFT (specifically reverse stagger mold TFT) as current control TFT, the top gate mold TFT may be used. Moreover, a hole injection layer 14, the luminous layer 15 which emits light in red, the luminous layer 16 which emits light green, the luminous layer 17 which emits light blue, or the electronic transportation layer 18 can use a well-known organic compound or a well-known inorganic compound respectively.
[0019] At this time, a singlet compound is used by this example as the luminous layer 16 which emits light green, and a luminous layer 17 which emits light blue, using a triplet compound as a luminous layer 15 which emits light in red. That is, the EL element using the singlet compound as an EL element which emits light green or blue is used using the EL element using the triplet compound as an EL element which emits light in red.
[0020] When using a low-molecular organic compound as a luminous layer, the life of the luminous layer which emits light in red in the present condition is shorter than the luminous layer which emits light in other colors. Since luminous efficiency is inferior to other colors, this must set up operating voltage highly, in order to obtain the same luminescence brightness as other colors, and is because advance of the part degradation is also early.
[0021] However, since the triplet compound with luminous efficiency high as a luminous layer 15 which emits light in red in this invention is used, though the same luminescence brightness as the luminous layer 16 which emits light green, or the luminous layer 17 which emits light blue is obtained, it is possible to arrange operating voltage. Therefore, it becomes possible to perform color display, without not bringing forward extremely degradation of the luminous layer 15 which emits light in red, and causing problems, such as a gap of color balance. Moreover, it is desirable that operating voltage can be stopped low also from the point that the margin of pressure-proofing of a transistor can be set up low.
[0022] In addition, although this invention shows the example using the triplet compound as a luminous layer 15 which emits light in red, it is possible to arrange the operating voltage of each EL element by using a triplet compound for the luminous layer 16 which emits light still greener, or the luminous layer 17 which emits light blue.
[0023] Next, the circuitry of the picture element part in the luminescence equipment of this invention is shown in drawing 2 . In addition, all of circuitry are the same although three of pixel (pixel (blue)) 20c containing pixel (pixel (red)) 20a containing the EL element which emits light in red here, pixel (pixel (green)) 20b containing the EL element which emits light green, and the EL element that emits light blue are illustrated.
[0024] In drawing 2 (A), 21 is [source wiring (data wiring), and 23a-23c of gate wiring, and 22a-22c] current supply source lines. The current supply source lines 23a-23c are wiring which determines the operating voltage of an EL element, and the same electrical potential difference is impressed also in which pixel of pixel 20a of red luminescence, pixel 20b of green luminescence, and pixel 20c of blue luminescence. Therefore, all the line breadth (size) of wiring is also good at the same design.
[0025] Moreover, 24a-24c are Switching TFT (TFT for controlling the signal inputted into the gate of the current control TFT), and are formed with the n channel mold TFT here. In addition, although structure with two channel formation fields is illustrated between a source field and a drain field here, you may be one or three or more.
[0026] Moreover, 25a-25c are the current control TFT (TFT for controlling the current which flows to an EL element), a source field is connected to either of the current supply source lines 23a-23c, and a drain field is connected to either of EL elements 26a-26c for the gate electrode of the current control 25a-TFT 25c at either of the switching 24a-TFT 24c. In addition, 27a-27c are capacitors, and hold the electrical potential difference respectively impressed to the gate electrode of the current supply source lines 25a-25c. However, Capacitors 27a-27c can also be omitted.
[0027] In addition, although drawing 2 (A) shows the example which formed the current control 25a-TFT 25c which consists of switching 24a-TFT 24c which consists of an n channel mold TFT, and a p channel mold TFT As shown in

drawing 2 (B), it is also possible to form the current control 29a-TFT 29c which consists of switching 28a-TFT 28c which becomes each of pixel (red) 30a, pixel (green) 30b, and pixel (blue) 30c from the p channel mold TFT, and an n channel mold TFT.

[0028] Furthermore, although drawing 2 (A) and (B) show the example which prepared two TFT(s) in one pixel, the number of TFT may be three or more (typically three - six). Also in such a case, it does not matter even if it prepares combining the n channel mold TFT and the p channel mold TFT how.

[0029] In drawing 2 (A) and (B), EL element 26a is the EL element of red luminescence, and uses the triplet compound as a luminous layer. Moreover, EL element 26b is [the EL element of green luminescence and EL element 26c] the EL elements of blue luminescence, and all use the singlet compound as a luminous layer.

[0030] It becomes possible to make the same (V or less [10] preferably 3-10V) all operating voltage of the EL element which emits light in red by using a triplet compound and a singlet compound properly as mentioned above, the EL element which emits light green, and the EL element which emits light blue. Therefore, since a gap of the color balance by the difference in the life of an EL element can be controlled and a power source still more nearly required for luminescence equipment can be unified by 3V or 5V, there is an advantage from which a circuit design becomes easy.

[0031]

[Embodiment of the Invention] Suppose that detailed explanation is given about the gestalt of operation of this invention using the example shown below.

[0032]

[Example] [Example 1] This example shows the example (however, condition in front of the closure) of luminescence equipment with the drive circuit which drives a picture element part and it on the same insulator as luminescence equipment of this invention to drawing 3 . In addition, the CMOS circuit used as a base unit is shown in the drive circuit 150, and one pixel is shown in a picture element part 151. However, in fact, two or more pixels gather and the structure of a picture element part 151 becomes, as shown in drawing 1 .

[0033] In drawing 3 , 100 is an insulator (a substrate with an insulating substrate, an insulator layer, or an insulator layer is included on a front face), and the current control TFT204 which consists of switching TFT203 which consists of the n channel mold TFT201, a p channel mold TFT202, and an n channel mold TFT, and a p channel mold TFT is formed on it. At this time, the circuitry of a picture element part 151 has structure shown in drawing 2 (A). Moreover, in this example, all TFT(s) are formed with the reverse stagger mold TFT.

[0034] First, the structure of the n channel mold TFT201 and the p channel mold TFT202 is explained.

[0035] the n channel mold TFT201 -- setting -- 101 -- a gate electrode and 102 -- gate dielectric film and 103 -- for a LDD (light doped lane) field and 106, as for the 1st interlayer insulation film and 109, a channel formation field, a 107-channel protective coat, and 108 are [a source field and 104 / a drain field, and 105a and 105b / source wiring and 110] drain wiring.

[0036] the p channel mold TFT202 -- setting -- 111 -- a gate electrode and 102 -- for a drain field and 114, as for the 1st interlayer insulation film and 116, a channel formation field, a 115-channel protective coat, and 108 are [gate dielectric film and 112 / a source field and 113 / source wiring and 110] drain wiring. This drain wiring 110 is the n channel mold TFT201 and common wiring.

[0037] Although switching TFT203 has structure with two channel formation fields between the source field and the drain field, since he can understand easily if explanation of the structure of the n channel mold TFT201 is referred to, explanation is omitted. Moreover, since he can understand the current control TFT204 easily if explanation of the structure of the p channel mold TFT202 is referred to, explanation is omitted.

[0038] And the n channel mold TFT201, the p channel mold TFT202, switching TFT203, and the current control TFT204 are covered, and the 2nd interlayer insulation film (flattening film) 119 is formed.

[0039] In addition, before the 2nd interlayer insulation film 119 is formed, on the drain field 117 of the current control TFT204, the contact hole 118 is formed at the 1st interlayer insulation film 108. In case this forms a contact hole in the 2nd interlayer insulation film 119, it is for simplifying an etching process.

[0040] Moreover, a contact hole is formed in the 2nd interlayer insulation film 119 so that it may arrive at the drain field 117, and the pixel electrode 120 connected to the drain field 117 is formed. The pixel electrode 120 functions as an anode plate of an EL element, and the oxide electric conduction film is used for the large electric conduction film of a work function, and a representation target. What is necessary is just to use indium oxide, the tin oxide, zinc oxides, or

those compounds as oxide electric conduction film.
[0041] Next, 121 is a bank and is the insulator layer prepared so that the edge of the pixel electrode 120 might be covered. What is necessary is just to form bank 121 by the insulator layer or resin film containing silicon. If a carbon particle or metal particles is added so that the specific resistance of the resin film may be set to 1x106 to 1x1012ohmm (preferably 1x108-1x1010ohmm) when using the resin film, dielectric breakdown at the time of membrane formation can be suppressed.
[0042] Next, 122 is EL layer. In addition, in this specification, the layered product which combined a hole injection layer, an electron hole transportation layer, the electron hole blocking layer, the electronic transportation layer, the electronic injection layer, or the electronic blocking layer to the luminous layer is defined as EL layer. The point which uses a singlet compound and a triplet compound together as this luminous layer is the description of this invention.
[0043] In addition, in this example, a singlet compound is used as an organic compound used for the EL element of green luminescence, and the EL element of blue luminescence, using a triplet compound as an organic compound used for the EL element of red luminescence. What is necessary is just to use Alq3 (aluminum kino RIRATO complex) which carried out vapor codeposition of the fluorochrome as a singlet compound as a triplet compound that what is necessary is just to use the above-mentioned organic compound at this time.
[0044] Next, 123 is the cathode of an EL element and the small electric conduction film of a work function is used. What is necessary is just to use the electric conduction film which contains the element belonging to one group of a periodic table, or two groups as small electric conduction film of a work function. In this example, the electric conduction film which consists of a compound of a lithium and aluminum is used.
[0045] In addition, the layered product 205 which consists of the pixel electrode (anode plate) 120, an EL layer 122, and cathode 123 is an EL element. Luminescence generated by EL element 205 is emitted to an insulator 100 side (the direction of the drawing Nakaya mark). Moreover, when using the p channel mold TFT for the current control TFT204 like this example, it is desirable to connect the anode plate of EL element 205 to the drain ficld 117 of the current control TFT204.
[0046] In addition, although not illustrated here, after forming cathode 123, it is effective to prepare the passivation film, as EL element 205 is covered completely. It consists of an insulator layer containing a carbon film, a silicon nitride film, or the nitriding oxidation silicon film as passivation film, and this insulator layer is used in a monolayer or the combined laminating.
[0047] Under the present circumstances, it is desirable to use the good film of coverage as passivation film, and it is effective to use a carbon film, especially the DLC (diamond-like carbon) film. Since the DLC film can be formed from a room temperature in a temperature requirement 100 degrees C or less, it can be easily formed also above the heat-resistant low EL layer 122. Moreover, the DLC film has the high blocking effectiveness over oxygen, and it is possible to control oxidation of the EL layer 122. Therefore, while performing the closure process which continues next, the problem that the EL layer 122 oxidizes can be prevented.
[0048] Since the luminescence equipment of this invention with the above picture element part and drive circuit of structure uses the singlet compound and the triplet compound properly to the EL element, it can arrange the operating voltage of an EL element and can perform good color display excellent in color balance.
[0049] Moreover, since all operating voltage of an EL element can be made into less than [10V] (typically 3-10V), the advantage that a circuit design becomes easy is acquired.
[0050] [Example 2] This example shows the example (however, condition in front of the closure) of luminescence equipment with the drive circuit which drives a picture element part and it on the same insulator as luminescence equipment of this invention to drawing 4 . In addition, the CMOS circuit used as a base unit is shown in the drive circuit 250, and one pixel is shown in a picture element part 251. However, the structure of a picture element part 251 is shown in drawing 1 in fact. Moreover, just refer to the explanation of an example 1 for the part to which the same sign as drawing 3 is given.
[0051] In drawing 4 , 100 is an insulator and the current control TFT207 which consists of switching TFT206 which consists of the n channel mold TFT201, a p channel mold TFT202, and a p channel mold TFT, and an n channel mold TFT is formed on it. At this time, the circuitry of a picture element part 251 has structure shown in drawing 2 (B). Moreover, in this example, all TFT(s) are formed with the reverse stagger mold TFT.
[0052] Since explanation of the n channel mold TFT201 and the p channel mold TFT202 should just refer to an

example 1, it is omitted. Moreover, although switching TFT206 has structure with two channel formation fields between the source field and the drain field, since he can understand easily if explanation of the structure of the p channel mold TFT202 is referred to, explanation is omitted. Moreover, since he can understand the current control TFT207 easily if explanation of the structure of the n channel mold TFT201 is referred to, explanation is omitted.
[0053] In the case of this example, the structure of an EL element differs from an example 1. The pixel electrode 302 is connected to the drain field 301 of the current control TFT207. The pixel electrode 302 is an electrode which functions as cathode of EL element 208, and is formed using the electric conduction film containing the element belonging to one group of a periodic table, or two groups. In this example, the electric conduction film which consists of a compound of a lithium and aluminum is used.
[0054] Moreover, EL element 208 consists of the pixel electrode (cathode) 302, an EL layer 303, and an anode plate 304. In addition, in this example, a singlet compound is used as an organic compound used for the EL element of green luminescence, and the EL element of blue luminescence, using a triplet compound as an organic compound used for the EL element of red luminescence. What is necessary is just to use Alq3 (aluminum kino RIRATO complex) which carried out vapor codeposition of the fluorochrome as a singlet compound as a triplet compound that what is necessary is just to use the above-mentioned organic compound at this time.
[0055] Moreover, in this example, the oxide electric conduction film which added the oxidation gallium is used for a zinc oxide as an anode plate 304. In order that this oxide electric conduction film may penetrate the light, luminescence generated by EL element 208 is emitted toward the top-face side (the direction of the drawing Nakaya mark) of an anode plate 304. In addition, when using the n channel mold TFT for the current control TFT207 like this example, it is desirable to connect the cathode of EL element 208 to the drain field 301 of the current control TFT207.
[0056] In addition, although not illustrated here, after forming an anode plate 304, it is effective to prepare the passivation film, as EL element 208 is covered completely. It consists of an insulator layer containing a carbon film, a silicon nitride film, or the nitriding oxidation silicon film as passivation film, and this insulator layer is used in a monolayer or the combined laminating.
[0057] Since the luminescence equipment of this invention with the above picture element part and drive circuit of structure uses the singlet compound and the triplet compound properly to the EL element, it can arrange the operating voltage of an EL element and can perform good color display excellent in color balance.
[0058] Moreover, since all operating voltage of an EL element can be made into less than [10V] (typically 3-10V), the advantage that a circuit design becomes easy is acquired.
[0059] In addition, the configuration of this example can be carried out combining the configuration indicated by the example 1.
[0060] [Example 3] This example explains the case where all of a picture element part and a drive circuit are formed with the n channel mold TFT, in the luminescence equipment of this invention. In addition, the circuitry of the pixel of this example serves as structure as shown in drawing 5 . Moreover, what is necessary is just to refer to explanation of drawing 2 about the part which attached the same sign as drawing 2 .
[0061] As shown in drawing 5 , Switching 24a-TFT 24c and the current control TFT 36a-36c which were prepared in each of pixel (red) 35a, pixel (green) 35b, and pixel (blue) 35c are altogether formed with the n channel mold TFT.
[0062] The cross-section structure (however, condition in front of the closure) of the luminescence equipment of this example is shown in drawing 6 here. In addition, the CMOS circuit used as a base unit is shown in the drive circuit 350, and one pixel is shown in a picture element part 351. However, the structure of a picture element part 351 is shown in drawing 1 in fact. Moreover, just refer to the explanation of an example 1 or an example 2 for the part to which the same sign as drawing 3 or drawing 4 is given.
[0063] In drawing 6 , 100 is an insulator and the current control TFT207 which consists of switching TFT203 which consists of the n channel mold TFT201, an n channel mold TFT209, and an n channel mold TFT, and an n channel mold TFT is formed on it. At this time, the circuitry of a picture element part 351 has structure shown in drawing 5 .
[0064] Moreover, in this example, all TFT(s) are formed with the reverse stagger mold TFT of an n channel mold. This time n channel mold TFT may be an enhancement type TFT altogether, and may be a depletion type TFT altogether. Of course, it is also possible to make, divide, combine and use both. It can be chosen as a channel formation field by adding the impurity of N type or P type whether it is made an enhancement type or it is made a depletion type.
[0065] The n channel mold TFT201 and the n channel mold TFT209 are the same structures, and since explanation

should just refer to an example 1, they omit it. Moreover, although switching TFT203 has structure with two channel formation fields between the source field and the drain field, since he can understand easily if explanation of the structure of the n channel mold TFT201 is referred to, explanation is omitted. Moreover, since he can understand the current control TFT207 easily if explanation of the structure of the n channel mold TFT201 is referred to, explanation is omitted.

[0066] In the case of this example, the structure of an EL element becomes being the same as that of an example 2. That is, in this example, in order to use the n channel mold TFT for the current control TFT207, it is desirable to connect the cathode 302 of EL element 208 to the drain field 301 of the current control TFT207. Just refer to the example 2 for the explanation about an EL element.

[0067] In addition, although not illustrated here, after forming an anode plate 304, it is effective to prepare the passivation film, as EL element 208 is covered completely. It consists of an insulator layer containing a carbon film, a silicon nitride film, or the nitriding oxidation silicon film as passivation film, and this insulator layer is used in a monolayer or the combined laminating.

[0068] Since the luminescence equipment of this invention with the above picture element part 351 and drive circuit 350 of structure uses the singlet compound and the triplet compound properly to the EL element, it can arrange the operating voltage of an EL element and can perform good color display excellent in color balance.

[0069] Moreover, since all operating voltage of an EL element can be made into less than [10V] (typically 3-10V), the advantage that a circuit design becomes easy is acquired.

[0070] Since the photolithography process for forming the p channel mold TFT can furthermore be skipped according to the configuration of this example, it is possible to simplify a production process.

[0071] In addition, the configuration of this example can be carried out combining the configuration indicated by the example 1 or the example 2.

[0072] [Example 4] This example explains the case where all of a picture element part and a drive circuit are formed with the p channel mold TFT, in the luminescence equipment of this invention. In addition, the circuitry of the pixel of this example serves as structure as shown in drawing 7 . Moreover, what is necessary is just to refer to explanation of drawing 2 about the part which attached the same sign as drawing 2 .

[0073] As shown in drawing 7 , Switching 51a-TFT 51c and the current control TFT 52a-52c which were prepared in each of pixel (red) 50a, pixel (green) 50b, and pixel (blue) 50c are altogether formed with the p channel mold TFT.

[0074] The cross-section structure (however, condition in front of the closure) of the luminescence equipment of this example is shown in drawing 8 here. In addition, the CMOS circuit used as a base unit is shown in a drive circuit, and one pixel is shown in a picture element part. However, the structure of a picture element part is shown in drawing 1 in fact. Moreover, just refer to the explanation of an example 1 or an example 2 for the part to which the same sign as drawing 3 or drawing 4 is given.

[0075] In drawing 8 , 100 is an insulator and the current control TFT204 which consists of switching TFT206 which consists of the p channel mold TFT210, a p channel mold TFT202, and a p channel mold TFT, and a p channel mold TFT is formed on it. At this time, the circuitry of a picture element part 451 has structure shown in drawing 7 .

[0076] Moreover, in this example, all TFT(s) are formed with the reverse stagger mold TFT of a p channel mold. This time p channel mold TFT may be an enhancement type TFT altogether, and may be a depletion type TFT altogether. Of course, it is also possible to make, divide, combine and use both. It can be chosen as a channel formation field by adding the impurity of N type or P type whether it is made an enhancement type or it is made a depletion type.

[0077] The p channel mold TFT210 and the p channel mold TFT202 are the same structures, and since explanation should just refer to an example 1, they omit it. Moreover, although switching TFT206 has structure with two channel formation fields between the source field and the drain field, since he can understand easily if explanation of the structure of the p channel mold TFT202 is referred to, explanation is omitted. Moreover, since he can understand the current control TFT204 easily if explanation of the structure of the p channel mold TFT202 is referred to, explanation is omitted.

[0078] In the case of this example, the structure of an EL element becomes being the same as that of an example 1. That is, in this example, in order to use the p channel mold TFT for the current control TFT204, it is desirable to connect the anode plate 120 of EL element 205 to the drain field 117 of the current control TFT204. Just refer to the example 1 for the explanation about an EL element.

[0079] In addition, although not illustrated here, after forming cathode 123, it is effective to prepare the passivation film, as EL element 205 is covered completely. It consists of an insulator layer containing a carbon film, a silicon nitride film, or the nitriding oxidation silicon film as passivation film, and this insulator layer is used in a monolayer or the combined laminating.
[0080] Since the luminescence equipment of this invention with the above picture element part 451 and drive circuit 450 of structure uses the singlet compound and the triplet compound properly to the EL element, it can arrange the operating voltage of an EL element and can perform good color display excellent in color balance.
[0081] Moreover, since all operating voltage of an EL element can be made into less than [10V] (typically 3-10V), the advantage that a circuit design becomes easy is acquired.
[0082] Since the photolithography process for forming the n channel mold TFT can furthermore be skipped according to the configuration of this example, it is possible to simplify a production process.
[0083] In addition, the configuration of this example can be carried out combining the configuration indicated by the example 1 or the example 2.
[0084] [Example 5] This example shows the example which used the top gate mold TFT (specifically planar mold TFT) as Switching TFT or current control TFT.
[0085] The cross-section structure of the picture element part in the active-matrix mold luminescence equipment of this example is shown in drawing 9 . In drawing 9 , the luminous layer to which in an insulator and 911 the current control TFT and 912 emit light to a pixel electrode (anode plate) and a hole injection layer with 913 [well-known / a bank and 914], and 915 emits [910] light in red, the luminous layer to which 916 emits light green, the luminous layer to which 917 emits light blue, an electronic transportation layer with well-known 918, and 919 are cathode.
[0086] At this time, a singlet compound is used by this example as the luminous layer 916 which emits light green, and a luminous layer 917 which emits light blue, using a triplet compound as a luminous layer 915 which emits light in red. That is, it is the EL element which emits light green [the EL element using a singlet compound], or blue, and the EL element using said triplet compound is an EL element which emits light in red.
[0087] In this example, since the triplet compound with luminous efficiency high as a luminous layer 915 which emits light in red is used, though the same luminescence brightness as the luminous layer 916 which emits light green, or the luminous layer 917 which emits light blue is obtained, it is possible to arrange operating voltage. Therefore, it becomes possible to perform color display, without not bringing forward extremely degradation of the luminous layer 915 which emits light in red, and causing problems, such as a color gap. Moreover, it is desirable that operating voltage can be stopped low also from the point that the margin of pressure-proofing of a transistor can be set up low.
[0088] In addition, although this example shows the example using the triplet compound as a luminous layer 915 which emits light in red, it is also possible to use a triplet compound for the luminous layer 916 which emits light still greener, or the luminous layer 917 which emits light blue.
[0089] Moreover, the circuitry of this example is the same configuration as drawing 2 . Of course, it is also possible to consider as which configuration of examples 1-4.
[0090] [Example 6] The luminescence equipment of this invention after going by this example to the closure (or enclosure) process for protecting an EL element is explained using drawing 10 (A) and (B). In addition, although this example shows the example which closes the structure shown in the example 1 (drawing 3), closure structure of this example can be carried out also to which structure shown in the example 1 - the example 5. Moreover, the sign of drawing 3 is quoted if needed.
[0091] The plan showing the condition that drawing 10 (A) performed even the closure of an EL element, and drawing 10 (B) are the sectional views which cut drawing 10 (A) by A-A'. As for a picture element part and 502, 501 shown by the dotted line is [a source side drive circuit and 503] gate side drive circuits. Moreover, as for covering material and 505, 504 is [the 1st sealant and 506] the 2nd sealant.
[0092] In addition, 507 is wiring for transmitting the signal inputted into the source side drive circuit 502 and the gate side drive circuit 503, and receives a video signal and a clock signal from FPC (flexible print circuit)508 used as an external input terminal. In addition, although only FPC is illustrated here, the printed-circuit base (PWB) may be attached in this FPC.
[0093] Next, cross-section structure is explained using drawing 10 (B). The picture element part 501 and the source side drive circuit 502 are formed above the insulator 100, and a picture element part 501 is formed of two or more

pixels containing the pixel electrode 120 electrically connected to the current control TFT204 and its drain. Moreover, the source side drive circuit 502 is formed using the CMOS circuit which combined the n channel mold TFT201 and the p channel mold TFT202. In addition, a polarizing plate (typically circular polarization of light plate) may be stuck on an insulator 501.

[0094] The pixel electrode 120 functions as an anode plate of an EL element. Moreover, bank 121 is formed in the both ends of the pixel electrode 120, and the EL layer 122 and the cathode 123 of an EL element are formed on the pixel electrode 120. Cathode 123 functions also as wiring common to all pixels, and is electrically connected to FPC508 via the connection wiring 507. Furthermore, all the components contained in a picture element part 501 and the source side drive circuit 502 are covered by the passivation film 509.

[0095] Moreover, the covering material 504 is stuck by the 1st sealant 505. In addition, a spacer may be formed in order to secure spacing of the covering material 504 and an EL element. And the opening 510 is formed inside the 1st sealant 505. In addition, as for the 1st sealant 505, it is desirable that it is the ingredient which penetrates neither moisture nor oxygen. Furthermore, it is effective to prepare the matter which has the moisture absorption effectiveness in the interior of an opening 510, and the matter with the antioxidizing effectiveness.

[0096] In addition, it is good for the front face and rear face of the covering material 504 to form carbon films (specifically diamond-like carbon film) 511a and 511b in the thickness of 2-30nm as a protective coat. Such a carbon film has the role from which the front face of the covering material 504 is protected mechanically while preventing invasion of oxygen and water.

[0097] Moreover, after pasting up the covering material 504, the 2nd sealant 506 is provided so that the disclosure side of the 1st sealant 505 may be covered. The 2nd sealant 506 can use the same ingredient as the 1st sealant 505.

[0098] By enclosing an EL element with the above structures, an EL element can be completely intercepted from the outside and it can protect from the exterior that the matter to which degradation by oxidation of EL layers, such as moisture and oxygen, is urged invades. Therefore, reliable luminescence equipment is obtained.

[0099] In addition, as shown in drawing 10 (A) and (B), the luminescence equipment which has a picture element part and a drive circuit, and was attached to FPC on the same substrate is called drive circuit built-in luminescence equipment especially in this specification.

[0100] [Example 7] In an example 6, although the drive circuit built-in luminescence equipment shown in drawing 10 is the example by which the picture element part and the drive circuit were really formed on the same insulator, it is also possible to prepare a drive circuit by external IC (integrated circuit). In such a case, structure becomes like drawing 11 (A).

[0101] FPC63 is attached in the substrate 60 (a picture element part 61 and Wiring 62a and 62b are included) with which the picture element part in which the module shown in drawing 11 (A) contains TFT and an EL element was formed, and the printed wired board 64 is attached through the FPC63. The functional block diagram of a printed wired board 64 is shown in drawing 11 (B) here.

[0102] As shown in drawing 11 (B), IC which functions at least as I/O Ports (it is also called an input or the output section) 65 and 68, the source side drive circuit 66, and a gate side drive circuit 67 is prepared in the interior of a printed wired board 64.

[0103] Thus, the module of a configuration of that FPC was attached in the substrate with which the picture element part was formed in the substrate side, and the printed wired board which has a function as a drive circuit through the FPC was attached is made to call it a drive circuit external mold luminescence module especially on these specifications.

[0104] Moreover, FPC74 is attached in drive circuit built-in luminescence equipment 70 (a picture element part 71, the source side drive circuit 72, the gate side drive circuit 73, and Wiring 72a and 73a are included), and, as for the module shown in drawing 12 (A), the printed wired board 75 is attached through the FPC74. The functional block diagram of a printed wired board 75 is shown in drawing 12 (B) here.

[0105] As shown in drawing 12 (B), IC which functions as I/O Ports 76 and 79 and the control section 77 at least is prepared in the interior of a printed wired board 75. In addition, although the memory section 78 is formed here, it is not necessarily required. Moreover, the control section 77 is a part with the function for controlling control of a drive circuit, amendment of image data, etc.

[0106] Thus, the module of a configuration of that the printed wired board which has a function as a controller to the

drive circuit built-in luminescence equipment with which the picture element part and the drive circuit were formed in the substrate side was attached is made to call it a controller external mold luminescence module especially on these specifications.

[0107] [Example 8] The luminescence equipment (the module of the gestalt shown in the example 7 is also included) formed by carrying out this invention is built in various electric appliances, and a picture element part is used as the graphic display section. As an electric appliance of this invention, the picture reproducer equipped with a video camera, a digital camera, a goggles mold display (head mount display), a navigation system, an audio equipment, the note type personal computer, the game device, the pocket device (a mobile computer, a cellular phone, a handheld game machine, or digital book), and the record medium etc. is mentioned. The example of these electric appliances is shown in drawing 13 and drawing 14 .

[0108] Drawing 13 (A) is an EL display and contains a case 2001, susceptor 2002, and a display 2003. The luminescence equipment of this invention can be used for a display 2003. When using luminescence equipment with an EL element for a display 2003, since an EL element is a spontaneous light type, it can consider as a display unnecessary [a back light] and thin.

[0109] Drawing 13 (B) is a video camera and contains a body 2101, a display 2102, the voice input section 2103, the actuation switch 2104, a dc-battery 2105, and the television section 2106. The luminescence equipment of this invention can be used for a display 2102.

[0110] Drawing 13 (C) is a digital camera and includes a body 2201, a display 2202, an eye contacting part 2203, and the actuation switch 2204. The luminescence equipment or the liquid crystal display of this invention can be used for a display 2202.

[0111] drawing 13 -- (-- D --) -- a record medium -- having had -- picture reproducer (specifically DVD regenerative apparatus) -- it is -- a body -- 2301 -- record media (CD, LD, or DVD) -- 2302 -- actuation -- a switch -- 2303 -- a display -- (-- a --) -- 2304 -- a display -- (-- b --) -- 2305 -- containing . Although a display (a) mainly displays image information and a display (b) mainly displays text, the luminescence equipment of this invention can be used for these displays (a) and (b). In addition, CD regenerative apparatus, a game device, etc. are contained in the picture reproducer equipped with the record medium, and it sells to it.

[0112] Drawing 13 (E) is a pocket mold (mobile) computer, and contains a body 2401, a display 2402, the television section 2403, the actuation switch 2404, and a memory slot 2405. The luminescence equipment of this invention can be used for a display 2402. This pocket mold computer can record information on the record medium which integrated a flash memory and nonvolatile memory, or can reproduce it.

[0113] Drawing 13 (F) is a personal computer and contains a body 2501, a case 2502, a display 2503, and a keyboard 2504. The luminescence equipment of this invention can be used for a display 2503.

[0114] Moreover, the above-mentioned electric appliance displays more often the information distributed through electronic communication lines, such as the Internet and CATV (cable television), and its opportunity to display especially animation information has been increasing. When luminescence equipment with an EL element is used for a display, since the speed of response of an EL element is very high, a movie display without delay becomes possible.

[0115] Moreover, in order that the part which is emitting light may consume power, as for luminescence equipment, it is desirable to display information that the amount of light-emitting part decreases as much as possible. Therefore, when using luminescence equipment for the display which is mainly concerned with text like a Personal Digital Assistant especially a cellular phone, or an audio equipment, it is desirable to drive so that text may be formed by part for a light-emitting part by making a nonluminescent part into a background.

[0116] Drawing 14 (A) is a cellular phone, is the part (control unit) 2601 which performs a key stroke, and the part (information-display section) 2602 which performs an information display, and has connected a control unit 2601 and the information-display section 2602 in the connection section 2603 here. Moreover, the voice input section 2604 and the actuation key 2605 are formed in a control unit 2601, and the voice output section 2606 and a display 2607 are formed in the information-display section 2602.

[0117] The luminescence equipment of this invention can be used for a display 2607. In addition, when using luminescence equipment for a display 2607, the power consumption of a cellular phone can be stopped by displaying a white alphabetic character on a black background.

[0118] In the case of the cellular phone shown in drawing 14 (A), a sensor (CMOS sensor) can be made to be able to

build in the luminescence equipment used for the display 2604 by the CMOS circuit, and it can also use by reading a fingerprint or the lines on the palms as a terminal for authentication systems which attests a user. Moreover, light can also be made to emit so that external brightness (illuminance) may be read and an information display may become possible by the set-up contrast.

[0119] Furthermore, if brightness is lowered and use of an actuation switch finishes while using the actuation switch 2605, it can low-power-ize by raising brightness. Moreover, when a message is received, the brightness of a display 2604 can be raised, and it can low-power-ize also by lowering brightness during a message. Moreover, when using it continuously, unless it resets, low-power-ization can also be attained by giving the function in which a display will be OFF by time control. In addition, these may be manual control.

[0120] Moreover, drawing 14 (B) is an audio for mount, and includes a case 2701, a display 2702, and the actuation switches 2703 and 2704. The luminescence equipment of this invention can be used for a display 2702. Moreover, although this example shows the audio for mount (car audio) as an example of an audio equipment, you may use for a non-portable audio (audio component). In addition, when using luminescence equipment for a display 2704, power consumption can be stopped by displaying a white alphabetic character on a black background.

[0121] Furthermore, the electric appliance shown above can make a photosensor able to build in the luminescence equipment used for the display, and can also establish a means to detect the brightness of an operating environment. When using luminescence equipment for a display, a function which modulates luminescence brightness according to the brightness of an operating environment can also be given.

[0122] The image sensors (the shape of a field, sensor of linear or punctiform) formed in the luminescence equipment specifically used for the display by the CMOS circuit can be formed, or it can carry out by preparing CCD (Charge Coupled Device) in a body or a case. A user can recognize an image or text satisfactory, if the brightness of 100-150 is securable by the contrast ratio compared with the brightness of an operating environment. That is, it is possible to raise the brightness of an image, to make it legible, when an operating environment is bright, to stop the brightness of an image, when an operating environment is dark, and to stop power consumption.

[0123] As mentioned above, the applicability of this invention is very wide, and using for the electric appliance of all fields is possible. Moreover, the electric appliance of this example may use luminescence equipment or a module including which configuration of examples 1-7.

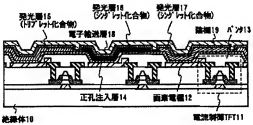
[0124]

[Effect of the Invention] By carrying out this invention, it becomes possible to arrange the operating voltage of the EL element of red luminescence, EL ** of green luminescence, and the EL element of blue luminescence, and the luminescence equipment which makes good color display of color balance possible can be offered.

[0125] Moreover, an electric appliance with the good display of image quality can be offered by using for a display the luminescence equipment which makes good color display of color balance possible.

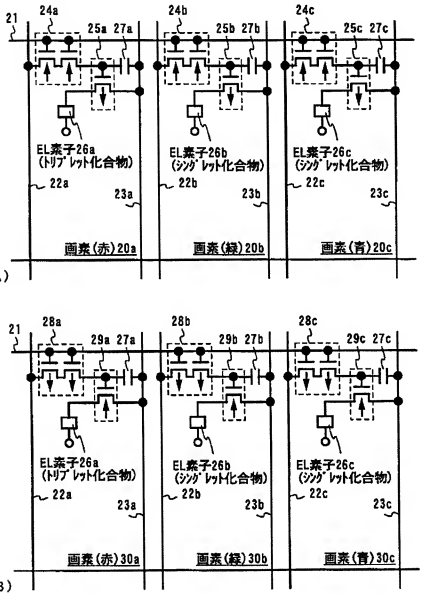
[Translation done.]

Drawing selection drawing 1



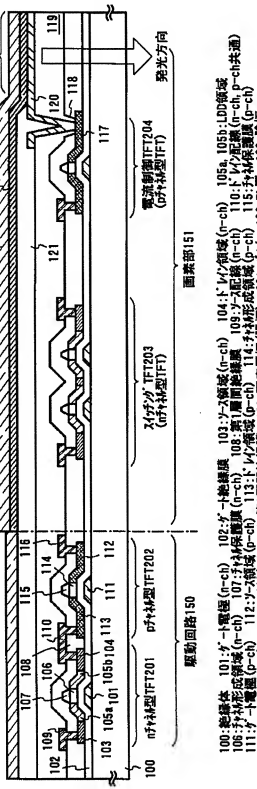
[Translation done.]

Drawing selection drawing 2



[Translation done.]

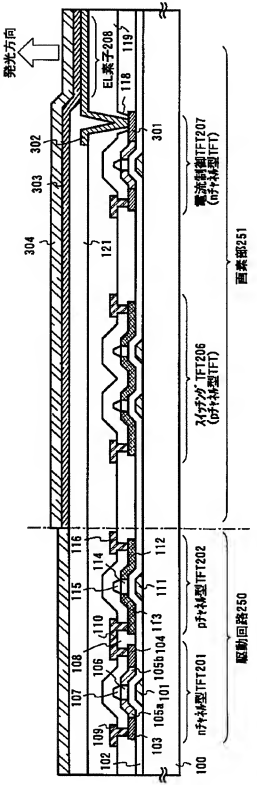
Drawing selection drawing 3



100:絶縁体 101:ゲート電極(n-ch) 102:ゲート絶縁膜 103:ソース領域(n-ch) 104:ドレイン領域(n-ch) 105a, 105b:LDD領域
106:チャネル形成領域(n-ch) 107:チャネル保護膜(n-ch) 108:第1層間絶縁膜 109:ソース配線(n-ch) 110:ドレイン配線(n-ch, p-ch共通)
111:ゲート電極(p-ch) 112:ソース領域(p-ch) 113:ドレイン領域(p-ch) 114:チャネル形成領域(p-ch) 115:チャネル保護膜(p-ch)
116:ソース配線(p-ch) 118:コンタクトホール 119:第2層間絶縁膜 120:画素電極(陽極) 121:バンク 122:EL層 123:陰極

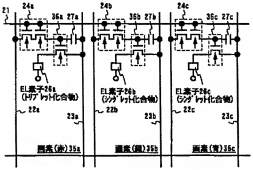
[Translation done.]

Drawing selection drawing 4



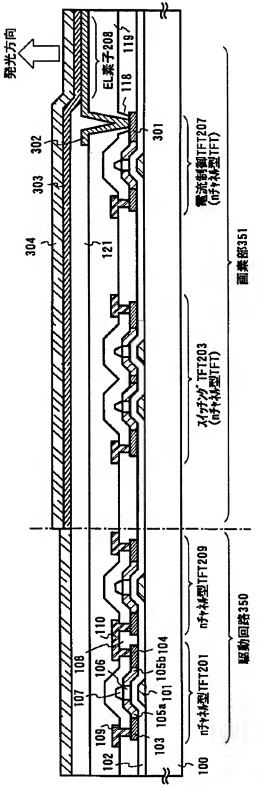
[Translation done.]

Drawing selection drawing 5



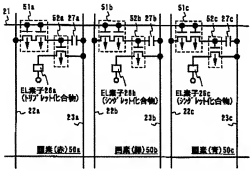
[Translation done.]

Drawing selection drawing 6



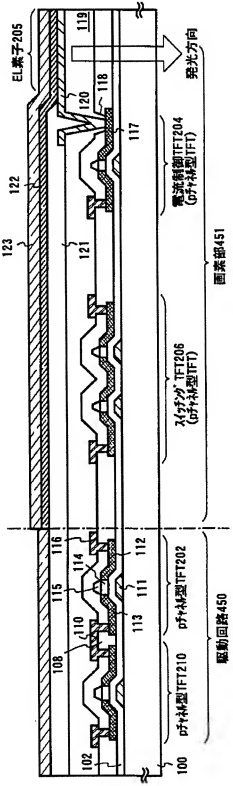
[Translation done.]

Drawing selection drawing 7



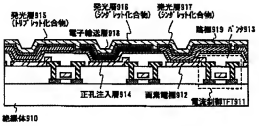
[Translation done.]

Drawing selection drawing 8



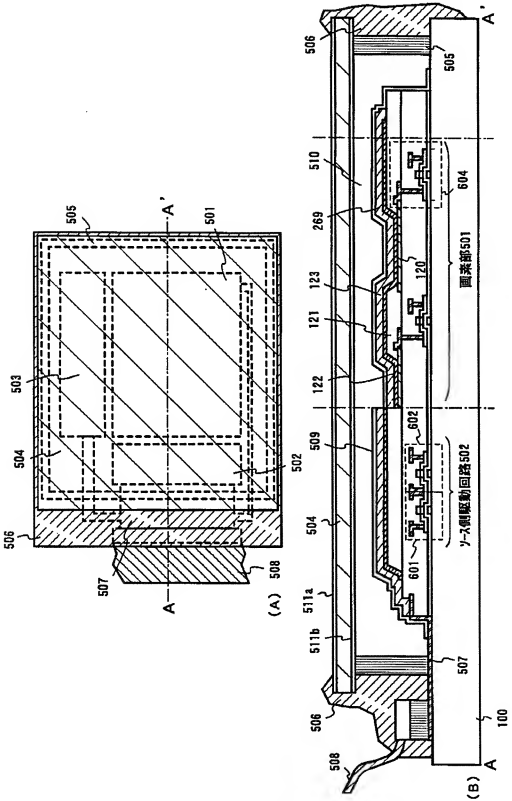
[Translation done.]

Drawing selection drawing 9



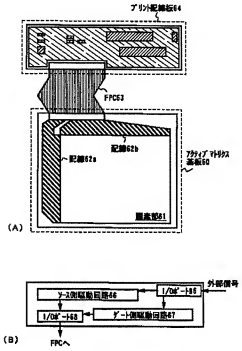
[Translation done.]

Drawing selection drawing 10

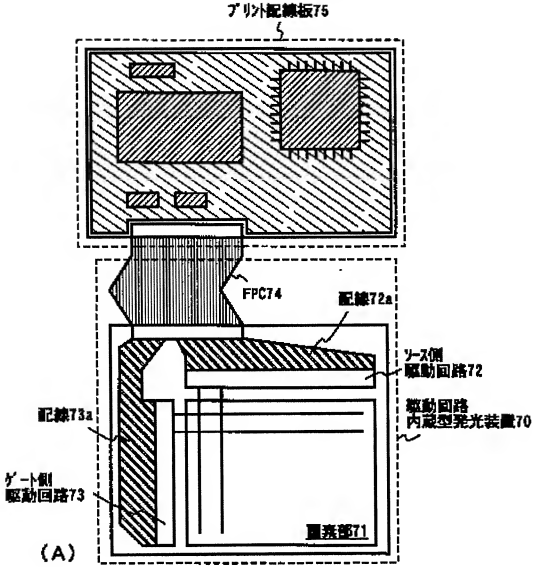


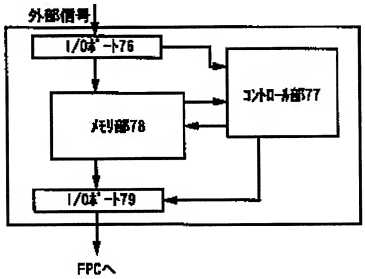
[Translation done.]

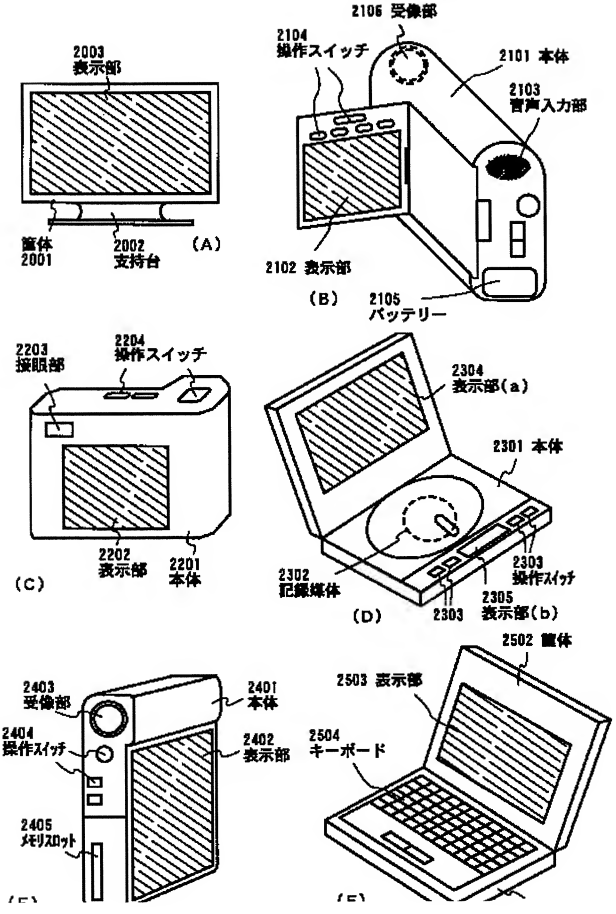
Drawing selection drawing 11

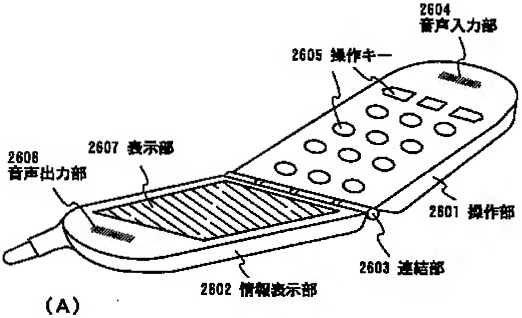


[Translation done.]

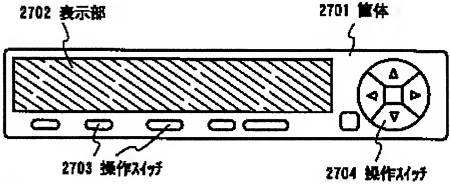

プリント配線板75
FPC74
配線72a
ソース側
駆動回路72
駆動回路
内蔵型発光装置70
配線73a
ゲート側
駆動回路73
画素部71
(A)


外部信号
I/Oポート76
コントローラ部77
メモリ部78
I/Oポート79
(B)
FPCへ


2003
表示部
筐体
2001
2002
支持台
(A)
2106 受像部
2104
操作スイッチ
2101 本体
2103
音声入力部
2102 表示部
(B)
2105
バッテリー
2203
接眼部
2204
操作スイッチ
2202
表示部
2201
本体
(C)
2304
表示部(a)
2301 本体
2302
記録媒体
2303
操作スイッチ
2303
2305
表示部(b)
(D)
2403
受像部
2401
本体
2404
操作スイッチ
2402
表示部
2405
メモリスロット
(E)
2502 筐体
2503 表示部
2504
キーボード
(F)


2604
音声入力部
2605 操作キー
2607 表示部
2608
音声出力部
2601 操作部
2603 連結部
2602 情報表示部

(A)


2702 表示部
2701 筐体
2703 操作スイッチ
2704 操作スイッチ

(B)